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Art. XVII.—*The Longevity of Cut Flowers.*

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In studying the question of the longevity of cut flowers, the first thing to be taken into account is the reason or reasons which cause cut flowers to die, or to lose their characters as flowers by passing into the fruiting condition.

That is, flowers may undergo either :—

(1) Withering of the sepals and petals due to passage from the flowering to the fruiting stage.

(2) Falling of the sepals and petals due to the same cause.

(3) Abnormal premature withering.

The last cause is naturally the only one to be considered when dealing with the longevity of cut flowers.

Abnormal withering may be caused in various ways :—

(1) By the blocking of the vessels preventing the rise of sap and, as transpiration continues, resulting in a loss of turgor, followed by drooping.

(2) By self-poisoning, owing to an exudation of poison from cells near the cut surface.

In the work that has been done up to date no actual case of premature withering due to poisoning has been proved. The manner in which cases of possible poisoning were tested was as follows :—Some of the suspected material was thoroughly ground and squeezed, and an extract made, in one case by boiling in water, and in the other by soaking for a considerable period in cold water. Fresh flowers were then placed in the extract, which should contain the poison in concentrated form, but in every case the material in the extract lasted just as well as the control, proving that there cannot have been much, if any, poison present in the extract.

The most frequent cause of abnormal withering is, therefore, some form of blocking of the vessels with a resultant loss of turgor. That blocking does actually take place can easily be seen by sectioning the stem at short distances from the cut ends, and examining the vessels under a microscope.

This blocking may be caused by external factors, or by factors within the plant itself. The most common external cause is the development of bacteria in the water surrounding the stem. This is especially likely to happen if flowers are placed in dirty vessels, or vessels in which the water has been left standing for some time. The bacteria enter the vessels of the stem at the cut end, the sap being an attraction, and after a time form a complete block, preventing the ascent of water. This may happen to practically any plant, and the most effectual remedy is to change the water frequently, and by so doing the accumulation of bacteria is checked.

Internal causes of blocking are a great deal more difficult to discover and define. There may be an exudation of wound gum into the vessels, or the parenchyma cells surrounding the vessels may develop outgrowths which push their way into the lumina, and finally form a parenchymatous tissue completely blocking the vessels, and very effectively retarding the ascent of sap. This condition is known as the formation of a tylosis.

In order to prevent withering in these cases, it will be necessary to keep the vessels clear, either by preventing the exudation or the abnormal growth taking place, or by dissolving it as rapidly as it is formed. This will have to be done by placing the stem in some solution which will perform the required action without at the same time having any harmful effect on the living tissues of the plant.

The work was commenced with any plants that happened to be blooming at the time, and various well known household methods for preserving flowers were tested. Placing the stems in boiling water, removing the bark for some distance up the stems, and charring the stems, all proved equally unsuccessful with the flowers used. The only one found to be of the slightest use was in the case of dahlias, which, if inclined to droop, would when placed in boiling water, very often completely revive.

Chrysanthemums and wattles are very inclined to show sudden abnormal drooping, and in one or two cases this was proved to be due to the present of masses of bacteria blocking the vessels, while in others what seemed to be a gummy precipitate could be seen in the vessels by examining a section of the stem. Since the blocking and consequent withering take place very rapidly, it is most probably caused by an internal secretion of a gummy nature. If this is the case it should be able to be prevented by placing the stems, either in a solution which will cause a precipitation on the

walls of the vessels of the gummy substance directly it is formed and so prevent further exudation, or in a solution which will dissolve the exudation as fast at it enters the vessels.

Various tests were attempted to try and discover the solubility of the blocking material, but without success. If the material should be wound gum, which appears most likely, it ought to be able to be detected by testing with phloroglucin and hydrochloric acid, with which it should give a bright red colour, but no colour change was observable. A special stain for wound gum which should stain it in contrast to the surrounding tissues known as Hanstein's mixture, composed of equal parts of concentrated alcoholic solution of Fuschin and Methyl Violet, also gave no result.

Numerous tests for showing the presence of tannin were also attempted, especially on sections of Acacias, but although the presence of extensive tannin was shown in the cortex, medullary rays, and pith, the actual blocking substance in the vessels gave no definite tannin reaction.

The exact nature of the substance exuded from the surrounding cells into the vessels and causing blocking, therefore, remains doubtful, although it is most probably a form of wound gum which will not react to the colour tests.

Although the chemical nature of the substance exuded into the vessels remains undiscovered, an effective means was found of preventing the blocking in Acacias. It was found that if fresh specimens of Acacias, soon after being taken from the trees, are placed in a dilute solution of the non-poisonous heavy metals, no blocking occurs, and the flowers remain nearly perfect for a considerable period. The metal which proved most successful was lead, the nitrate, and the acetate being the salts most used, as they are the only two lead compounds easily soluble in water. Silver nitrate in dilute solution also proved fairly effective, but owing to its power of rapid decomposition it is somewhat unsuitable. Soluble mercury salts, presumably owing to their poisonous properties, proved rapidly harmful, while the other members of the group were not suitable for use.

The following tables give some idea of the effect that immersion of the stems in a weak solution of lead nitrate has on various species of wattle. It would be difficult to say exactly which day a certain mass of wattle flower actually died, therefore in the following tables the condition of the flowers at intervals of two, six, and fourteen days was noted. In a good many cases the flowers

did not shrivel and droop at all; apparently, if it had not been for other causes, they would have kept indefinitely, but in every case, after from ten to fourteen days, the specimens would become discoloured. This discolouring would commence with the part of the stalk actually immersed in lead nitrate, and gradually spread until it affected the whole stalk, leaves, and, lastly flowers, so that in no case could the flowers really be called fresh for more than fourteen days.

In many cases the articulation between the pedicels of the capitula and the stems become loosened, with the consequence that the capitula fall off very easily, although remaining quite fresh.

It will be seen that the exact effect of the lead nitrate varies with the different species; for example, no experiments with Acacia armata succeeded, and the effect on other markedly xerophytic species, such as juniperina and verticillata, was very slight. A good deal of variation is noticeable in the effect of the lead nitrate on different specimens of the same variety. In some experiments the control and the specimens in lead nitrate have lasted for an equally short period, whereas another experiment with the same variety will give a good result. In all cases where rapid withering has taken place detailed sectioning and examination of the stem shows blocking. There is presumably some undetermined factor which controls the extent of the exudation, and the effect which immersion of the stem in lead nitrate will have on this. It is possible that the length of time intervening between the time that the blossom is picked, and the time that it is placed in the solution will have a considerable influence on its longevity. Accurate experiments to determine this point have not yet been carried out; but it was noticed that in any case where the blossom had been kept for some time, and had begun to wither, the lead nitrate did not exert a reviving effect, but the specimen would remain in a drooping condition for a long time, whereas the control would completely wither. That is, the lead nitrate does not dissolve blocking already formed, but prevents any further exudation taking place. Another possible factor influencing the amount of blocking shown in the stem might be the age of the wood forming the vessels at the cut part. This point was also undetermined.

Tables to show the influence of varying strengths of lead and silver salts on the longevity of the blossoms of varying species of Acacias.

[The number of days quoted under each column indicates the number of days that the specimens remain fresh.]

Species.	Control. Days.	Lead nitrate .5% Days.	Lead nitrate 1% Days.
A. saligna	2	6	6
A. salicinia	2	2	2
A. montana	2	6	6
A. prominens	2	6	6
A. stricta	2	14	14
A. fimbriata	2	14	14
A. diffusa	2	14	14
A. neriifolia	6	14	14
A. leprosa	6	14	14
A. longifolia	6	14	14

	Control. Days.	Lead nitrate 1% Days.
A. rubida	6	14
A. pycnantha	2	14
A. longifolia, var. sophora	2	14
A. decurrens var. normalis	2	6
A. cultriformis	2	14
A. myrtifolia	6	14
A. dodonaeifolia	6	14

	Control. Days.	Silver nitrate 1% Days.	Lead nitrate 1% Days.
A. sclerophylla	2	6	6
A. venulosa	2	6	14
A. spectabilis	2	6	14
A. saligna	2	14	14

	Control. Days.	Lead nitrate 1% Days.	Lead acetate 1% Days.
A. retinodes	6	14	14
A. lophantha	6	14	14
A. armata	2	2	2
A. juniperina	2	6	6
A. verticillata	2	6	6
A. acinacea	2	2	2
A. neriifolia	2	14	14
A. melanoxylon	2	6	6

In order to prove that the solution of lead nitrate did actually prevent blocking in the vessels, and allowed a freer passage through the stems the following experiment was performed.

Two short stems of as nearly as possible the same length and diameter were fixed in a perpendicular position. To the upper end of each was attached a small rubber tube connected with a small reservoir, while to the lower end a small graduated flask was also connected by a rubber tube.

Reservoir A, attached to Stem A, was filled with water, and Reservoir B, attached to Stem B, was filled with a 1% solution of

lead nitrate. The reservoirs, which were the same size, provided an equal pressure on each stem, and should force an equal amount of liquid through the stems into the graduated flasks. The stems being of equal diameter, they should have approximately the same number of vessels, and unless blocking occurred in one and not in the other, the same amount of water and lead nitrate should pass through in the same time.

Experiment 1.—Time, one hour.

Stem A, water only, amount collected ... ... .25 ccs.

Stem B, lead nitrate, amount collected ... ... 5 ccs.

Experiment 2.—Time, 45 minutes.

Stem A, water only, amount collected ... ... .5 ccs.

Stem B, lead nitrate, amount collected ... ... 5 ccs.

Experiment 3 (with same stem as Experiment 2).—Time, one hour 15 minutes.

Stem A, amount collected ... ... .7 ccs.

Stem B, amount collected ... ... 7 ccs.

Experiment 4.—Time, two hours.

Stem A, water only, amount collected ... ... .5 ccs.

Stem B, lead nitrate, amount collected ... ... 3.5 ccs.

Experiment 5.—Time, three hours.

Stem A, water only, amount collected ... ... .5 ccs.

Stem B, lead nitrate, amount collected ... ... 5 ccs.

These experiments show that the vessels are more open to the passage of lead nitrate solution than water. The viscosity of the lead nitrate solution is slightly greater than that of water, but its density is greater, and the greater head balances the higher viscosity largely. Neither factor would cause more than a 5 to 10% difference in the rate of flow, whereas the differences observed amount to 700 to 1000%, and this fact can only be explained by presuming that some form of blocking of the vessels intervenes to prevent the passage of water, but this is not developed when lead nitrate is passed through instead of water. This is proved by microscope examination of sections of the stems which have been used in the experiments. Stem A showed extensive blocking, whereas the vessels in Stem B were quite empty and with open lumina.

This method of preserving wattle blossom could be quite easily carried out in the household. A few crystals of lead nitrate to a quart of water should make a solution of a sufficient strength to preserve the blooms without having any harmful effect.